



Possible Impacts of Smart Contracts on Construction Claim Management

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Abstract. The information age and digital transformation challenge the construction industry's traditional business methods and current dynamics. Smart contracts are recently adopted in the construction industry to digitally facilitate the exchange of money, content, property, shares, and digitized asset. In this context, the usage of smart contracts is expected to impact the claims encountered in construction projects and the traditional claim management processes. This study aims to analyze the possible effects of smart contracts on construction claim management. A structured literature analysis was undertaken to determine the benefits that smart contracts may offer in this context. As a result, a research roadmap is developed to discuss the steps needed to integrate smart contracts in the construction claim management field. The study findings show that smart contracts may have considerable benefits in the claim management process including, record integrity, elimination of unnecessary bureaucracy, reliability of documents, reduction of transaction costs, and enhancing transparency.

Keywords: Construction Claim Management · Smart Contracts

1 Introduction

Smart contracts are self-executing programs that are frequently utilized for the execution of automated transactions decided upon by the parties (Governatori et al. 2018). The term “smart contract” was introduced by Nick Szabo in 1994 for the first time (Szabo 1994). Although there are numerous definitions for smart contracts today, non of them are widely accepted (Tanrıaşıklı and Taş 2023). The construction sector has lately used smart contracts to digitally simplify the exchange of funds, content, assets, shares, and other digital assets. Many project management tools and contracts in the industry are impacted and digitally renewed with the integration of the most recent information technology advancements (Li and Kassem 2021). The supply chain, in particular, can gain from smart contracts used in the construction industry (Hamledari and Fischer 2021). The need for the industry to adopt and integrate emerging technologies occurred due to complex and large-scale construction projects and the management of associated processes (Hargaden et al. 2019). Depending on the project, there is considerable uncertainty. Construction project technologies are not without their own uncertainties. Conflicts between stakeholders result from these uncertainties (Çevikbaş and Köksal

2018). By using smart contracts, inconsistent project data in building projects can be automatically identified, therefore common frauds in the construction sector can be identified and eliminated (Le Tran and Leirvik, 2020). Smart contracts are a practical and viable alternative to lengthy, intricate, and unintelligible building contracts (Koç, and Gürgün 2020). According to Christidis and Devetsikiotis (2016), smart contracts are digital programs based on the blockchain consensus architecture that self-execute when the conditions of the agreement are satisfied and are self-enforcing, agentless, and tamper-proof due to their decentralized nature. Smart contracts have the capacity to adopt concrete solutions based on the outcomes of this approach, in addition to standard contract terms and conditions, as well as procedures such as data collecting from external sources and processing in accordance with the terms stipulated in the contract. Smart contracts are designed to create outputs in accordance with the conditions they specify while minimizing errors and any resulting repercussions. The conditions of the smart contracts are written in a particular programming language that makes use of blockchain technology (Saygili et al. 2022). When the requirements of the contract are satisfied, the smart contract executes autonomously without the assistance of a third party, once it is uploaded to the blockchain network (Buterin 2014).

Recent studies have brought up smart contracts' potential for contract administration, however, very little research has been undertaken on the potential effects of smart contracts on construction claim management. The main objective of this article is to propose a research roadmap for improving the claim management process in the construction industry by utilizing smart contracts. A survey of the literature and expert interviews were performed to determine the advantages of using smart contracts. Several databases were used to gather the required publications, including Academic Info, Google Scholar, ResearchGate, ScienceDirect, and WorldWideScience.

2 Literature Review

Physical labor is required in the construction and building sector, and the timeliness, cost, and quality of the information are crucial (Cardeira 2015). A key difficulty in this area is conveying the appropriate information to the appropriate individual at the appropriate time, place, and location. Social interactions and human decisions also play a significant role in this (Dakhli et al. 2019). Identification and prioritization of risks, the identification of control points, and support for project risk management techniques are crucial for the successful implementation of smart contracts in the construction industry. Project success is significantly impacted by the management of contracts, thus deploying smart contracts on a blockchain system can reduce the risk factors related to human mistakes (Abdul-Rahman et al. 2014). Smart contracts have the ability to enhance the payment system and secure claim control, which are two main issues that the construction industry faces. On the other hand, acceptance, stability, reliability, and interoperability are some possible obstacles to the use of smart contracts (Hargaden et al. 2019).

3 Construction Claim Management

During the implementation of a project, various problems may arise among the participants. These problems often involve the contractor requesting either an extension of time or compensation for additional costs or sometimes both. The contractor's requests are referred to as "claims." The issue is remedied if the owner accedes to the contractor's request and gives an extension of time or payment for additional charges. A dispute, as depicted in Fig. 1, may arise if the owner disputes the contractor's assertion and there is a difference in interpretation.

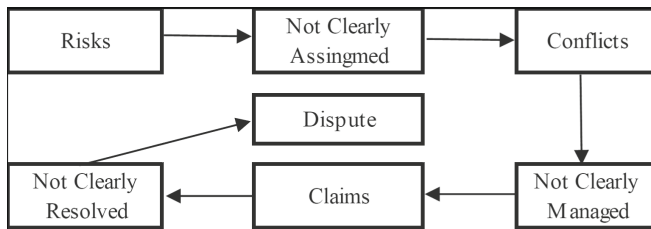


Fig. 1. Risks, Conflict, Claims, and Dispute Continuum Model (Dhanke and Futane 2020)

It is critical for all parties involved to be knowledgeable about the procedures and systems in place, including resources for preventive measures when needed. Claims are a common occurrence in construction projects and can have a significant impact on cost and duration. To minimize conflicts and disagreements, strategies such as building trust, promoting teamwork and communication, jointly solving problems, and forming alliance and partnership arrangements are used. These arrangements can help prevent conflicts from arising. However, claims are a necessary aspect of construction as they help handle unexpected changes and events that fall outside the contract. They are the administrative processes used to deal with events like changes in conditions, design changes, flawed specifications, changes in quantities, delays, disruptions, and acceleration. While many claims can be resolved peacefully, the prior conflict between parties can sometimes lead to unnecessary disputes. Disputes should be prevented or resolved through the available resolution mechanisms in the construction process.

4 Smart Contracts

The use of smart contracts enables the connection of any valuable property to a contract through digital means, providing better monitoring and protection in cases where proactive measures are inadequate (Szabo 1994). Smart contracts are self-executing programs, often used for automated transactions agreed upon by the parties involved (Governatori et al., 2018). For instance, traditional money transfers only require a one-way transaction from the sender to the receiver, but contracts require mutual agreement from both parties. This complexity increases when there are more than two parties involved in the contract. Additionally, it is expected that contracts in construction projects will need to

be archived, but storing large amounts of digital data can become difficult and raises concerns about data preservation and storage device failure. The legality of smart contracts as a valid form of the legal contract is still a matter of debate, as a legal contract is defined as an agreement between parties and the use of computer code, machines, or source text raises questions about the legality of smart contracts.

5 Research Method

The first step of this study involved conducting a literature review. During this research, the definition, history, and working principles of smart contracts, as well as the different types of smart contracts were explored in depth. The second phase involved conducting a structured literature search to investigate the possible application of smart contracts for claim management in the construction sector. Figure 2 shows how this analysis was carried out. The literature search utilized the “Google Scholar, ASCE, and Science Direct” databases and used keywords such as “Construction Claim Management” and “Smart Contracts”. Relevant articles, reports, conference papers, and theses were selected, and those not related to the construction industry were eliminated. A research map was created to identify similar and related studies. Finally, the impact of smart contracts on claim management in the construction industry was analyzed, and the benefits they can offer were discussed.

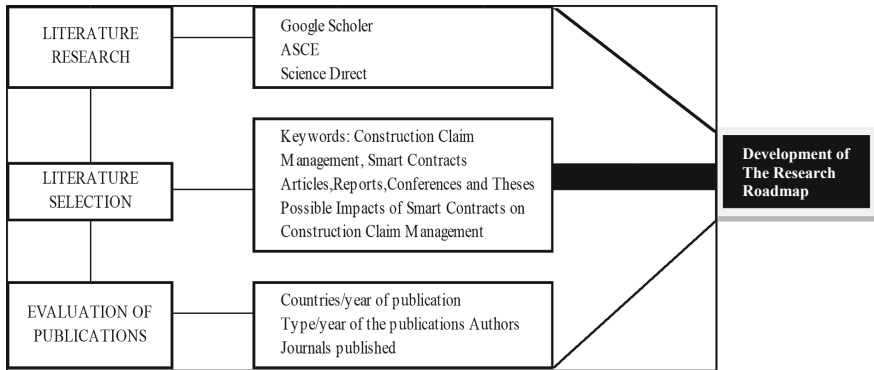


Fig. 2. Analysis Steps

6 Possible Impacts of Smart Contracts on Construction Claim Management: Research Map

The goal of this study is to examine the potential impacts of smart contracts on the administration of construction claims. The advantages that smart contracts can provide in this setting were determined through a methodical literature review. Some academics have found that smart contracts have various implications for the handling of construction claims. Positive aspects of the impact of smart contracts on claim management in the

construction industry include streamlined claims processing with reduced time and effort for manual verification and approvals, increased transparency and trust through access to the same information and encoded contract terms on the blockchain, and automated payments for efficient processing and payment of claims (Abdul-Rahman et al. 2014; Mason 2017). However, there are also negative aspects to consider, such as the complexity of design and implementation which can limit adoption by some organizations, security vulnerabilities in the code that can result in financial losses, and uncertainty about the legal status of smart contracts and potential issues with enforceability and jurisdiction (Wang et al. 2017). Claim management is impacted by smart contracts, as shown by a review of the most current studies. The notion of smart contracts is examined in the paper by Cardeira (2015) along with possible applications in the building sector. De Filippi et al. (2021) and Governatori et al (2018) investigated the differences between declarative and imperative smart contracts and discuss how smart contracts might be implemented in blockchain systems, providing a comprehensive analysis of the technological and legal aspects of smart contracts. Koç and Gürçün's (2020) study explores the factors that influence the adoption of smart contracts by those working in the construction industry. It focuses on the elements influencing the adoption of smart contracts in the construction industry. According to Nanayakkara et al. (2021). Smart contracts could be used to address payment-related problems in supply chains for the construction industry (2021). The authors argue that the use of smart contracts can speed up and improve the payment process, reducing the likelihood of payment disputes and increasing the business' overall transparency.

According to Wang et al. (2017), smart contracts are viewed as the construction industry's future. Smart contracts have a significant impact on the sector since they eliminate the need for middlemen and save time and money (Governatori et al., 2018). The rise of the construction business is impacted more firmly by updating contracts and tracking transactions. Smart contract implementation in the construction sector is crucial to promote accountability and prevent conflicts from arising in addition to increasing efficiency (Governatori et al., 2018). The application of smart contracts to construction projects can solve a number of current issues. According to Wang et al. (2017), automating the smart contract will not only improve the project's value but also ensure that the contract's provisions are automatically carried out. It will be more challenging for the parties to behave illegally. According to McNamara and Sepasgozar (2018), having a completely defined dispute procedure that is based on logic will increase automation and management capability as well as significantly improve efficiency. General contractors, subcontractors, and suppliers can be protected against insolvency due to late payments using smart contracts, money, or cryptocurrencies. According to Wang et al. (2017), a smart contract can pay the provider as soon as a shipment is delivered. According to Nanayakkara et al. (2021). Ahmadisheykhsarmast, and Sonmez 2020). a company can use blockchain to record the receipt of a specific good, or if the product has GPS functionality, payment can be made immediately when it arrives at the required place. The efficiency of the contract administration procedure has improved along with smart contracts. Thanks to automation, smart contracts can save a significant amount of time as compared to regular contracts when it comes to contract registration, tracking, and updating. It saves money and time and lessens the need for managers and lawyers (Behm

2008). In addition to being efficient, one of the major benefits of smart contracts is the high level of transparency for all stakeholders. Making the correct contracts and managing them well is crucial. For building projects, complicated contracts and conditions are frequently used. It might be challenging to reach all agreed-upon levels of cooperation between all partners throughout the course of a project. Smart contracts make it possible to guarantee that each activity always occurs in accordance with preset criteria (Msawil, 2022). According to Koç and Gürgün (2020), the five most crucial elements in the implementation of smart contracts are the ease of understanding by all parties, the reduction of customer risks, the clarity in responsibility and risk allocation, the reduction of disputes, and a simply readable contract layout. Smart contracts generally provide assurance that the required financing and funds will be available to finish the construction work, protection from late payments for main contractors, subcontractors, and suppliers, prevention of project participants' bankruptcies, the creation of a trustworthy environment, and time and money savings (Cardeira 2015). Even nations that are not interested in these innovations will soon need to put blockchain and smart contract technology on their agendas because they can be used almost anywhere there is the internet. It is crucial for professionals to quickly produce and develop legal and commercial policies pertaining to these systems.

Despite the proliferation of research on smart contracts and claim management, it has been revealed in this study that there are very few studies that combine the two. Future claim handling in the construction sector may be considerably improved by smart contracts. By automating payments, smart contracts can assist to decrease disputes and misunderstandings surrounding claim management and can enhance cash flow for construction companies. The construction business is a complex and dynamic one, therefore it's crucial to keep in mind that smart contracts' full potential has not yet been fully realized. As a result, the construction industry will need to adjust and integrate this technology in order to meet problems like those posed by laws and regulations, the complexity of designing and implementing smart contracts, and the requirement for technical skills and training.

The potential advantages of smart contracts should be understood by the construction industry, and it should think about investigating the technology to enhance its operations. To fully utilize smart contracts, the sector should be ready to invest in technical know-how and training. It should also be ready to collaborate with regulators, developers, and researchers to overcome any difficulties that may arise. It is difficult to estimate the proportion of contracts that are now being used as smart contracts because smart contracts are still a relatively new technology. Depending on the industry, the precise number of smart contracts in operation today will vary, but it's likely to be a small number. However, as more businesses start to use the technology, the use of smart contracts is projected to grow in the future. It is essential to provide technical expertise and training for producing this information if smart contracts are to actively participate in claim management in the building industry. To provide this training, it is necessary to make a specific investment. Cooperation between academics, developers, and regulators is necessary to tackle these challenges. Since smart contracts will be adopted more widely as technology develops, it is imperative that studies use technology to address these challenges.

As a part of the research roadmap, more empirical research is needed to demonstrate how smart contracts can be used in claim management. Durdu and Gökçe (2022) and Wüst and Gervais (2018) stated that smart contracts are an important topic for claim management and provided a brief scenario on how smart contracts can be used in claim management. For instance, the following scenario illustrates how smart contracts can be used in claim management. “ABC Company is a contractor that carries out construction works. ABC company’s client requested the provision of materials to be delivered on a specific date for the completion of the construction. ABC Company made an agreement with a supplier to procure the materials according to the contract terms. However, the supplier delivered the materials on a date and in an amount that did not comply with the contract terms. In this case, a smart contract could help to resolve such issues. The contract could contain a smart condition that requires the materials to be delivered on a specific date and in a specific amount. In addition, the contract could include an identity verification system that verifies the identities of the contract parties. When the supplier agrees to the terms of the smart contract for the delivery of materials, the contract automatically executes, and payment is made automatically when the materials are delivered on the specified date and in the specified amount. However, if the supplier fails to deliver the materials on a specific date or in a specific amount, the contract detects this and automatically stops the payment.” By automatically enforcing contract terms between parties and enabling quick resolution of issues, smart contracts can make claim management processes more effective.

7 Discussion and Conclusion

One of the most recent technological advancements in the building sector is smart contracts. The major goal is to carry out the construction job in a way that is more dependable, transparent, fair, and auditable. Construction work is highly involved compared to other industries and is carried out with numerous procedures among numerous players. When the literature is scanned, it becomes clear that the current studies are those that have been conducted during the recent few years, indicating that this research area has grown in popularity. According to the study’s findings, smart contracts have numerous advantages for the construction industry, including the ability to collaborate, lower costs, suitability, convenience, and transparency. They also provide dispute resolution, record integrity, stakeholder equality, and the elimination of needless red tape. Despite the fact that all studies on the subject have found ways to successfully integrate smart contracts into the sector, they all agree that the process will be challenging, particularly given how conservative and resistant to change the construction sector is. The hazards that the blockchain’s smart contract structure may encounter throughout the deployment phase, as well as its irreversibility, immutability, and gaps in legal restrictions, are mentioned in addition to these challenges. The difficulties, risks to reliability, and potential repercussions of the adoption of smart contracts in the construction sector have been the subject of studies. To better understand the risks and drawbacks as well as the advantages that smart contracts will bring to the construction sector, we advise expanding and analyzing the research that will be conducted in the future. It is crucial that smart contracts are widely used in various construction projects, that the requirements are clearly stated, and that solutions

are found for the challenges, security risks, and potential consequences that may develop in the future in order to reveal the potential effects of smart contracts in the future.

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